UAK Researcher School

Arctic Research Infrastructure and Interdisciplinary Research in Canada

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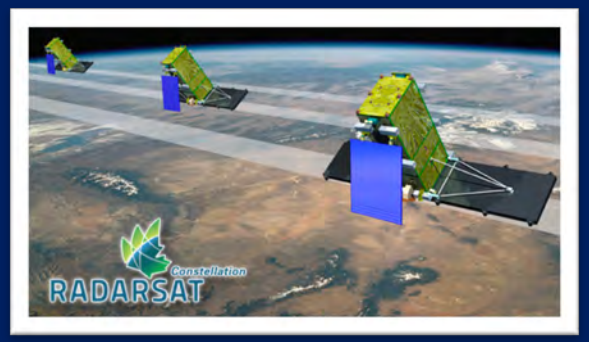
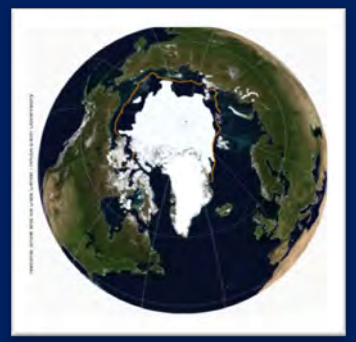
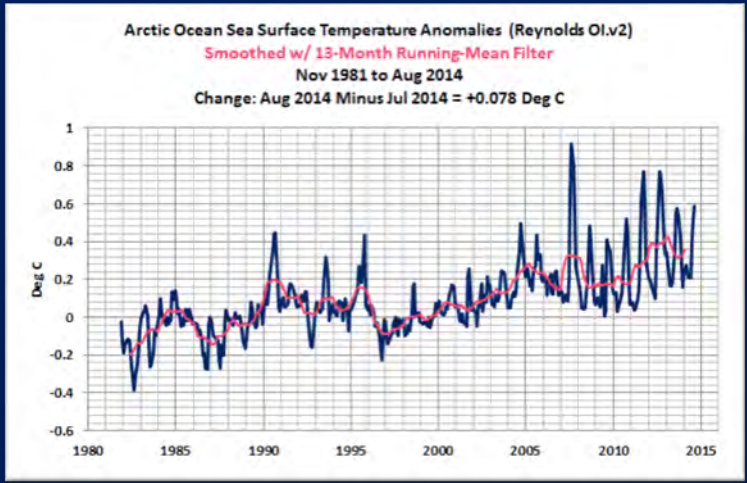
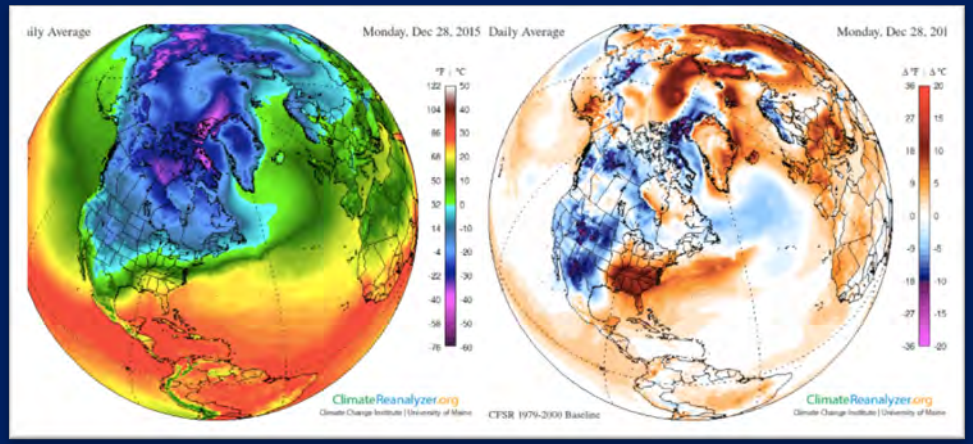
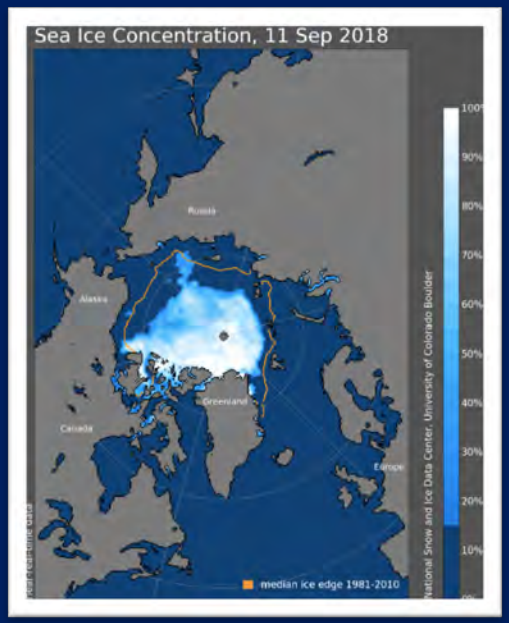


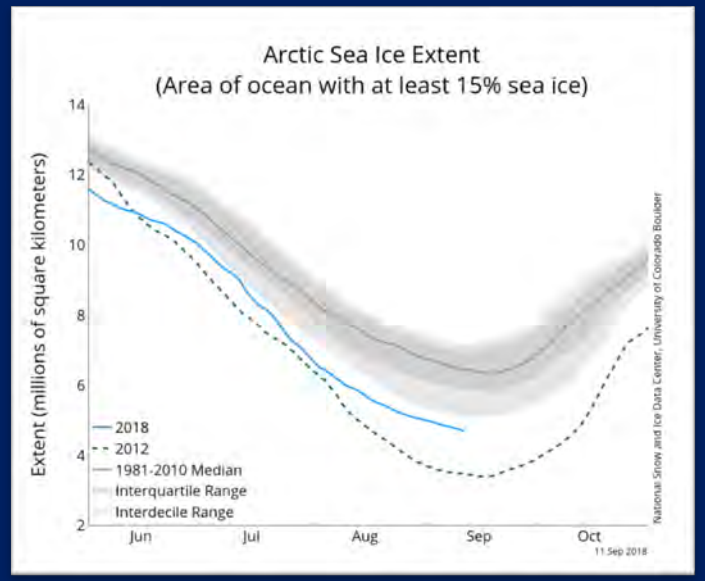


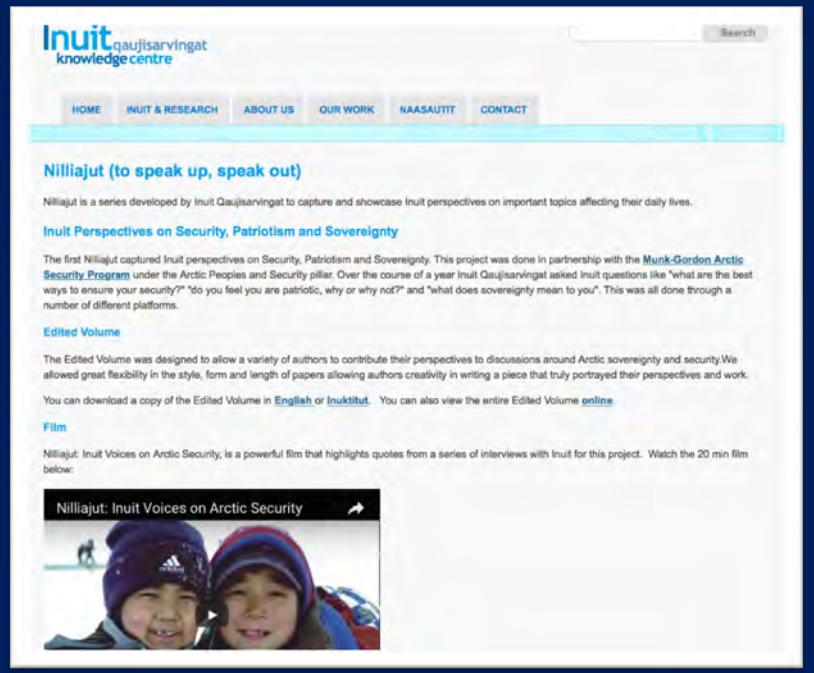
A Changing Arctic











Existing research Infrastructure (a few examples)

Network of northern research stations in Canada

Research vessels with icebreaking capacity

International Network for Terrestrial Research and Monitoring in the Arctic

Table 1. Major U.S. infrastructure (space-based, aircraft, ocean-based, field stations) needed to accomplish the five-year Arctic research plan. For each infrastructure element, its use, availability, and relevant sections of the plan are identified.

Infrastructure	Use	Availability	Section
Space-based			
Existing satellite missions critical to Arctic research			
NOAA satellite missions	Weather and key climate variables.	Available through 2017.	3.1–3.4
Defense Meteorological Satellite Program (DMSP)	Mapping sea ice with passive microwave.	Available through 2017.	3.1–3.4
NASA Earth Observing Satellites	Detailed studies of sea ice, clouds, and other Arctic parameters.	Many are past design life.	3.1–3.4
Joint Polar Satellite System (JPSS)	Next-generation weather satellite.	SUOMI-NPP has planned operational life to 2017; other satellites are in planning stages.	3.1–3.4
USGS Landsat-5 and -7	Agriculture, geology, forestry, regional planning, mapping, global change research, emergency response and disaster relief, education.	Landsat-5 launched in 1984 and still in operation, but data acquisition limited by an electronics problem. Landsat-7 launched in 1999 and still in operation. Minimum design life of 5 years.	3.1–3.4
SAR (Synthetic Aperture Radar)	Sea ice and glacier geophysics and mapping; Marine transportation support; Oceanography; Mapping—vegetation, geology, topography.	No U.S. SAR instruments available. Foreign SAR data (e.g., RADARSAT, TerraSAR-X, COSMO SkyMed) are available for purchase.	3.1–3.4
Satellites planned for launch by 2017			
USGS/NASA LandSat Data Continuity Mission (LDCM)	Agriculture, geology, forestry, regional planning, mapping, global change research, emergency response and disaster relief, education.	Launch in 2013.	3.1–3.4
NASA Global Precipitation Measurement (GPM)	Measure snowfall and heavy rain.	Launch in 2014; Limited footprint over polar regions.	3.3
NASA/DLR (Germany) Gravity Recovery and Climate Experiment (GRACE) follow-on	Arctic oceanography, changes in ice mass, terrestrial water storage.	Launch in 2017.	3.1–3.4
NASA Soil Moisture Active Passive (SMAP)	Soil moisture, freeze thaw patterns, and potentially sea-ice mapping.	Launch in 2015.	3.1–3.4
NASA ICESat 2	Altimetry over land and sea ice to measure changes in thickness.	Launch in 2016.	3.1–3.4

Gaps in Infrastructure

- Sustained observations in U.S. Maritime Arctic (Oct-Sep)
- Measurement sites driven by scientific, regulatory, logistic constraints
- Research, industry & regulators struggle with lack of sustained observations due to boom-bust cycles of resource development

Barriers to System-scale Interdisciplinary Research

Capacity

Technology

Human

Limitations on Data Management

Cost

Scaling up from the project level

Coordination of Funding

Long-term operation and maintenance

Data management

Competition

At the national level

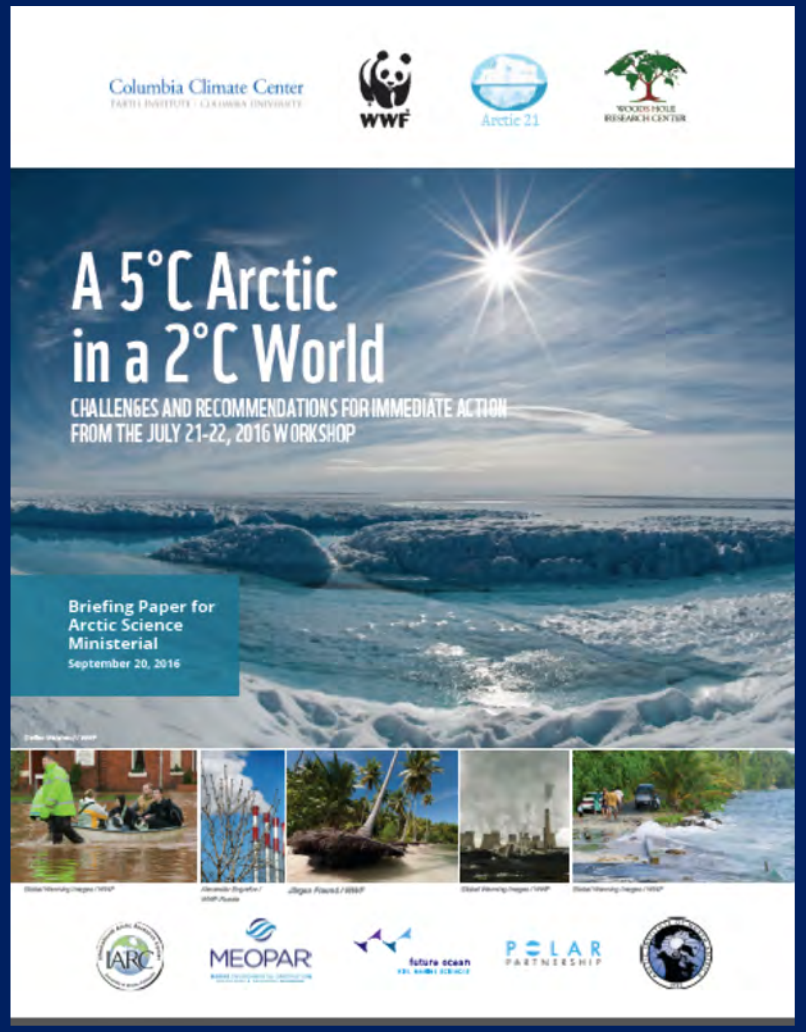
At the International level

Current reward system and the need for distributed infrastructure

Meeting Research Expectations

BIG QUESTIONS

- What will the Arctic look like in 2°C world?
- How will Arctic change impact the global community?
- How directly does Arctic change influence lower latitudes? In what ways?
- Is this Arctic change trajectory irreversible?
- Can we project future scenarios, interactions and feedbacks so as to improve decision making?
- What are Indigenous research priorities and how can we help to address these?



Meeting Other Expectations

- Arctic Council
  - Scientific Cooperation
  - Search and Rescue
  - Open and Interoperable Data
- Arctic Indigenous people
  - Adaptation and Desired futures
  - Protection and mobilization of Indigenous Knowledge
- Operational Agencies
- Private Sector
- Global Community

During the Arctic Summer Cloud Ocean Study (ASCOS) a tethered balloon was used to continuously lift a sensor package in the atmosphere between the surface and about 1 km altitude near N87deg, north of the Fram Strait. Photo: M. Tjernström

Solutions: Arctic Observing System

Research Infrastructure must be:

- **Distributed and integrated** one allowing for merging of data streams
- **focused** around central science questions and societal needs
- **relevant** to people's lives, decision making and policy
- **connected** with global observing systems

Observing System Design:

- is **critical**
- the system should be **responsive** to arctic system change
- responsive to needs for improved **understanding** and **adaptation** to and **mitigation** of change. (from: ISAC Science Plan 2010)

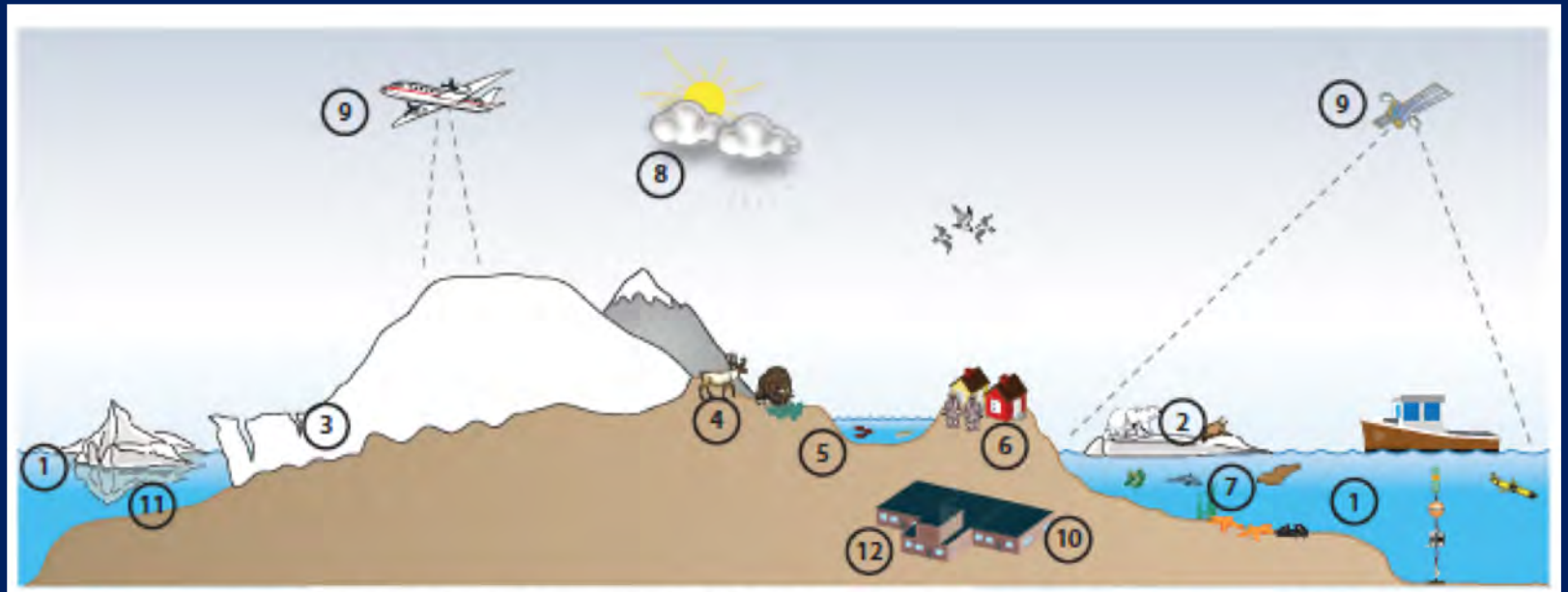


Figure 1. Conceptual model for core monitoring components in the different subprograms across BBOS. It will comprise field stations, vessels, extensive field instrumentation and community-based technologies. BBOS is an integrated baywide environmental observation system, that will enable a sustained year round, near real-time observation of the atmosphere, ice, land and ocean at the scale of an entire ocean basin (Baffin Bay). More information is provided in appendix.

CCADI

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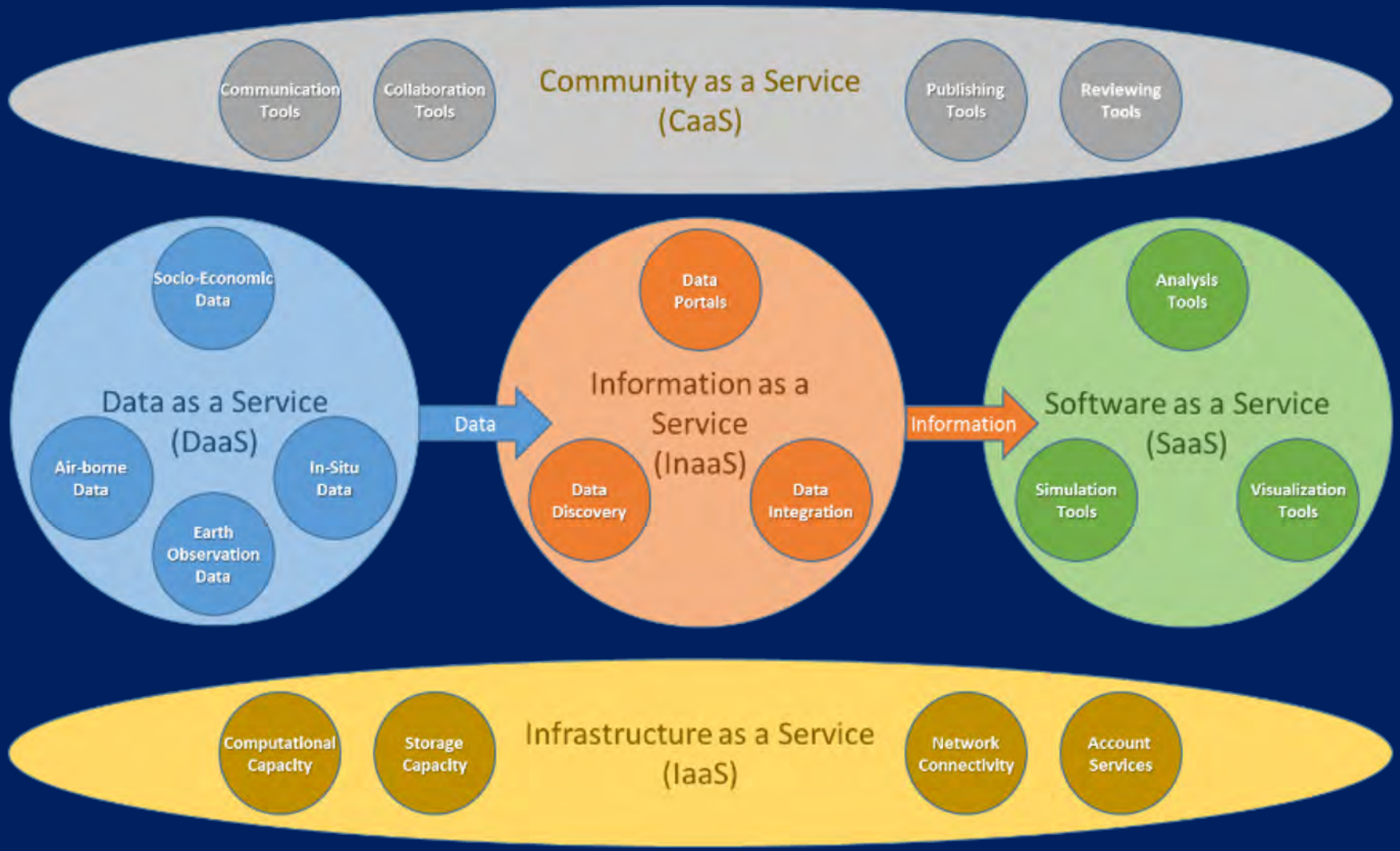
The Canadian Consortium for Arctic Data Interoperability

The CCADI is currently composed of a group of Canada's foremost Arctic scholars and Arctic data managers at the University of Calgary (Arctic Institute of North America), the University of Waterloo (Canadian Cryospheric Information Network and Polar Data Catalogue), Carleton University (Geomatics and Cartographic Research Centre), the University of Manitoba (Centre for Earth Observation Science), Université Laval (Centre d'études nordiques),University of Ottawa (Faculty of Law) Inuit Tapiriit Kanatami, Inuvialuit Regional Corporation, Natural Resources Canada, Polar Knowledge Canada, Cybera Inc., Polar View, and Sensor-Up Inc.

Read more

CCADI aims to advance collaboration, nationally and internationally, through development of an integrated Canadian arctic data management system that facilitates information discovery, establishes metadata and data sharing standards, enables interoperability among existing data infrastructures, and is accessible to the broadest possible audience of users.


Communication Tools
Collaboration Tools
Community as a Service (CaaS)
Publishing Tools
Reviewing Tools
Socio-Economic Data
Data as a Service (DaaS)
Air-borne Data
In-Situ Data
Earth Observation Data
Data
Data Portals
Information as a Service (InaaS)
Data Discovery
Data Integration
Information
Analysis Tools
Software as a Service (SaaS)
Simulation Tools
Visualization Tools
Computational Capacity
Storage Capacity
Infrastructure as a Service (IaaS)
Network Connectivity
Account Services

Work Packages

1. Project Governance, Policy, Management, Administration, Community Building
2. Foundational Protocols: legal, ethical, sensitive data; community-appropriate standards and technologies
3. Data Prep, QA/QC, Curation
4. ARDI Research Data Integration Platform
5. ARDI Mediation Platform
6. ARDI User Interfaces
7. Case Study

Work Package 6: ARDI USer Interfaces

Visualization Tools | Nunaliit Atlas Tools | Other Applications for Case study

Used For

Work Package 7
Case Study for ARDI Beta Testing

CCADI Discovery engine uses CCADI visualization tools

Work Package 5 - Analysis Platform

Polar TEP
Analytical Mediator

CCADI Discovery Engine
Federated Search and Discovery Aggregator
Can refer to similar services as Arctic Data Explorer, Polar Data Catalogue, GEOSS Portal

Other Services tied to research scenarios/case studies

Data Bypass Example: Data can go through the Data Bus, the value layer for integration, (if a partner node i.e., Amundsen Science) allows a client can go directly to the service endpoint provided by the node.

Legend
- Metadata Services
- Data Service
- Mediator/Aggregator Services
- Vector Data
- Raster Data
- Objects in Media
- Discovery
- Discovery Semantics

CCADI Arctic Research Data Infrastructure - Work Package 4 - Mediation and Integration
Data Bus: Technology integrates data feeds from partners; the Bus is both a mediator and data service for metadata and data

Transport Format Examples
GML, GEO ISON, CSV
GeoTiff, Binary, NETCDF
MP3, MP4
CJW
OAIç

Spatial
Geospatiial

Work Package 3

AINA
U Calgary

CCIN
U Waterloo

GCRC
Carleton U

CEN
U Laval

CEOS
U Manitoba

Amundsen Science

Inuvialuit Regional Corporation

Inuit Tapiriit Kanatami

Work Package 1 and 2: Activity across all partners including Federal (Polar, NRCan) and Polar View

Arctic Connect
ASTIS

Polar Data Catalogue

Nunaliit Atlases

Nordicana D

Datahub

AMUNDSEN DATA

Inuvialuit Indicators

Inuvialuit Settlement Region Platform

Digital Library

Inuvialuit Settlement Region Platform

Research Questions

1) **How are changing sea ice conditions influencing the Arctic ecosystems that support Inuit food security?** There are many dimensions to this topic that include the impact of climate change on sea ice formation and extent, the role(s) of sea ice in marine ecosystems, the socioecological relationship between Inuit and sea ice and coupling to food security, prosperity and well-being.

1) Questions from T-Mosaic (Coming up)

1) Changing cryosphere

T-MOSAiC

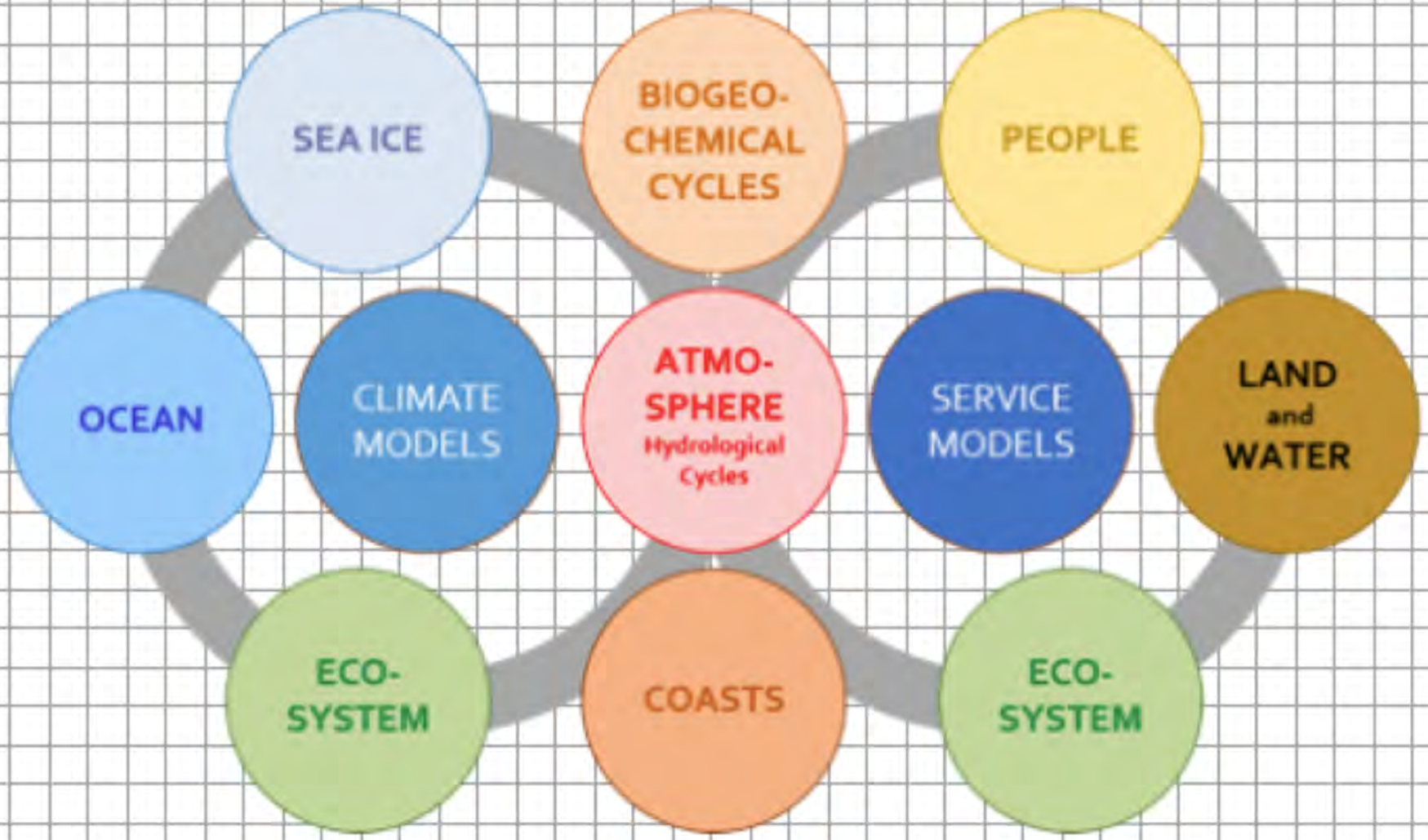
Terrestrial Multidisciplinary distributed Observatories for the Study of Arctic Connections

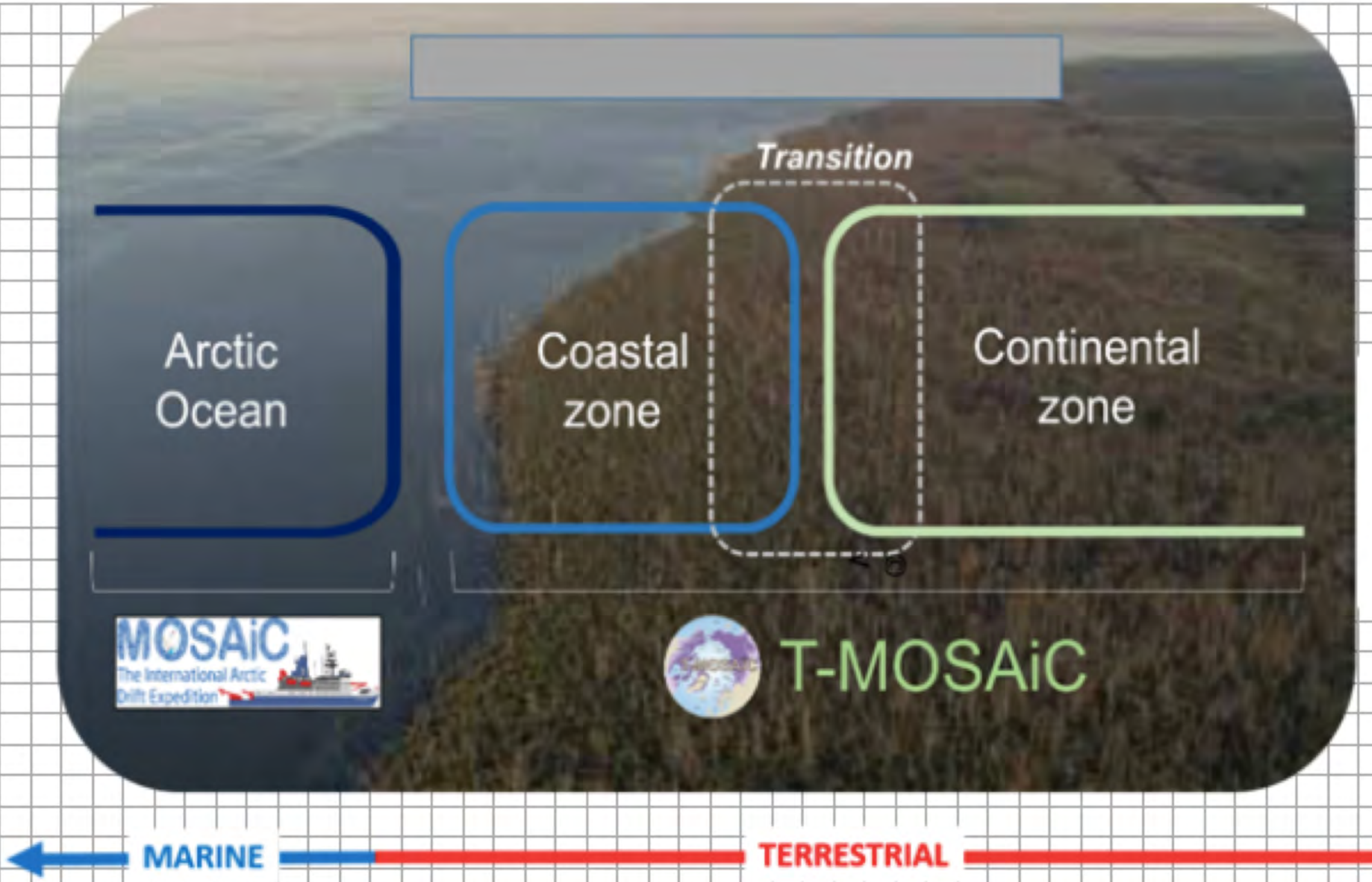
MOSAiC

Multidisciplinary **drifting Observatory** for the Study of **Arctic Climate**

T-MOSAiC

Terrestrial Multidisciplinary **distributed Observatories** for the Study of **Arctic Connections**




Transition
Arctic Ocean
Coastal zone
Continental zone
MOSAiC
The International Arctic Drift Expedition
T-MOSAiC
MARINE
TERRESTRIAL